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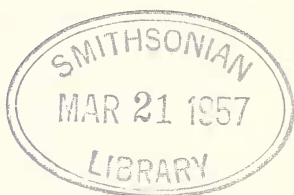
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## THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: General  
By E. YALE DAWSON



CONTRIBUTIONS IN SCIENCE is a series of miscellaneous technical papers in the fields of Biology, Geology and Anthropology, published at irregular intervals by the Los Angeles County Museum. Issues are numbered separately and numbers run consecutively regardless of subject matter. Number 1 was issued January 23, 1957. The series is available to scientists and scientific institutions on an exchange basis. Copies may also be purchased at a nominal price.

HILDEGARDE HOWARD

*Chief Curator of Science*

EDITOR

# THE MACHRIS BRAZILIAN EXPEDITION

BOTANY: General

By E. YALE DAWSON\*

The botanical work of the Machris Brazilian Expedition of 1956<sup>1</sup> was planned as an adjunct of the ornithological and entomological investigations in Goiás, but became, as a result of favorable circumstances in the field, an independent enterprise of somewhat greater magnitude than had been anticipated.

The following brief account is intended as a preliminary to the several systematic reports on the plant collections which will be presented from time to time as the work progresses.

It is my first privilege to thank Mr. and Mrs. Maurice A. Machris for their generosity in providing the funds, the facilities, and the enthusiastic stimulus which made possible the collecting and processing of these plant materials in the field under nearly ideal conditions. However, it was the result of a suggestion of Mrs. Maybelle Machris that the expedition included a botanist and, accordingly, I am grateful to her, both for that fortunate thought, and for her generosity in contributing to the Expedition's general financial needs.

During the course of the work in Brazil the writer received help in various ways from several individuals other than the members of the Expedition. Among these he especially wishes to thank Dr. Aylthon B. Joly of the University of São Paulo.

The work of identifying and processing the collections is now being done with the help of a number of specialists here in the United States, in Canada and in Europe, whose contributions to the work will be acknowledged within each publication unit.

The photographs were taken by Mr. Antenor Carvalho.

## EQUIPMENT AND ITINERARY

A general account and summary of the equipment and itinerary of the Expedition have been given by Jean Delacour in his paper introducing this series so that little in those respects need be repeated here. Briefly, however, the Expedition consisted of ten American and four Brazilian members, two 2-ton stake-body trucks, two custom-built carryalls, a trailer-mounted water purification unit, and a trailer-mounted Kohler electric generator and refrigeration plant. All food and equipment necessary to provide complete self-sufficiency in the field were

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<sup>1</sup>See the General Account of the Machris Brazilian Expedition by Jean Delacour: Los Angeles County Museum Contributions in Science (1): 1-12, 1957.

carried on the trucks and trailers so that base camps left little to be desired except air conditioning and freedom from black flies.

The Expedition left São Paulo on March 31, 1956 and proceeded almost due north to Anapolis near the state capital of Goiás (map 1). From this point we went during April to Base Camp I in a rolling highland known as the Chapada dos Veadeiros, and subsequently, during May, to Base Camp II in a low mountain range known as the Serra Dourada (map 2).

In going northeastward from Anapolis one travels into the Planalto Centrál of Brazil from which three major river systems arise. Here one crosses among rolling hills the east-west divide between the Amazon Basin and the Paraná Basin, a divide whose highest point is at 1380 meters in the Serra dos Pireneos. This highland region of Goiás, the Planalto Centrál, is bounded by the Rio São Francisco on the east, the Rio Grande tributary of the Paraná on the south and the Araguaia tributary of the Tocantins in the west. It is so favored climatically and so located geographically that the town known as Planaltina has been chosen as the site of the new Brazilian capital. Elevations range from 600 to over 1300 meters as one progresses from Planaltina onto the Chapada dos Veadeiros to its highest point which lies about midway between Veadeiros and Cavalcante. Our first base camp was established 20 km. north of São João da Aliança at somewhat over 1000 m. of elevation in the midst of a scrub-forest and grassland type of vegetation dissected by numerous small streams whose margins were occupied by forests of moderate height and density. From this camp the botanical collecting extended about 60 km. northward and to elevations of about 1300 m.

On the second leg of the Expedition we traveled northward from Anapolis along the west side of the Rio Tocantins drainage to as far as Peixe at S. Lat. 12° 01'. Most of the botanical collecting was done in the vicinity of the second base camp at an elevation of about 900 m.

At the established base camps dry botanical specimens were prepared for herbarium use by pressing freshly collected material in folded newspaper between building-felt driers alternating with aluminum corrugates. It was not necessary to change driers in the conventional manner, for the presses were placed in front of the warm air stream created by the radiator fan of the gasoline driven Kohler electric generator. With this excellent facility it was possible, even during rainy weather, to dry the majority of specimens in the space of 12 to 18 hours and, thus, to obtain good color preservation. Some 2000 herbarium specimens were prepared in this way during approximately forty-five field working days. After drying, the specimens were enclosed in dust-tight



galvanized sheet metal containers in crates and kept dehydrated by means of silica gel.

Some living plants were collected also, particularly Cactaceae, Orchidaceae, and Bromeliaceae which are now under cultivation in an effort to bring them into identifiable flowering condition.

#### HISTORY OF BOTANICAL EXPLORATION

By New World standards of time the history of botanical exploration in the Planalto Centrál of Brazil is long, extending back a hundred and forty years; but it is remarkable that more botanists visited the region during the first half of the 19th Century than during the first half of the 20th. Indeed, during the decade preceding 1820 Brazil was being botanized more extensively than any other part of the Americas.

Botany began in the Planalto in 1817 with the excursion of Karl Friedrich Philipp von Martius into the Chapada dos Veadeiros south-east of the old town of Cavalcante. Within the following three years, not only he, but two other now famous botanists rode, tramped and persevered in collecting across the region. Auguste de Sainte Hilaire visited, during 1819-21, both the Serra Dourada and the Corumbá area north of present day Anapolis, while Johann Emanuel Pohl, on two expeditions within the same years, collected in the Serra Dourada, along the upper Rio Maranhão, and near the headwaters of the Paraná in the Chapada dos Veadeiros south of Cavalcante. William John Burchell worked the region of Jaraguá north of Anapolis in 1827 and the vicinity of Cavalcante the following year. The Chapada dos Veadeiros was again visited in 1839-40 by George Gardner. The Rio Santa Teresa drainage, from near present day Porangatú to Peixe, was collected in 1844 by Hugh A. Weddell and F. de Castelnau. Their work in parts of Goiás extended through 1851, but it was over 40 years before another botanist studied the region, namely, Ernst H. G. Ule. Ule collected both in the Serra Dourada and in the Chapada dos Veadeiros in 1892-93 on an expedition to study the region of the proposed new capital in the Planalto Centrál<sup>2</sup>. He was followed in the same areas in 1894-95 by Auguste Françoise-Marie Glaziov.

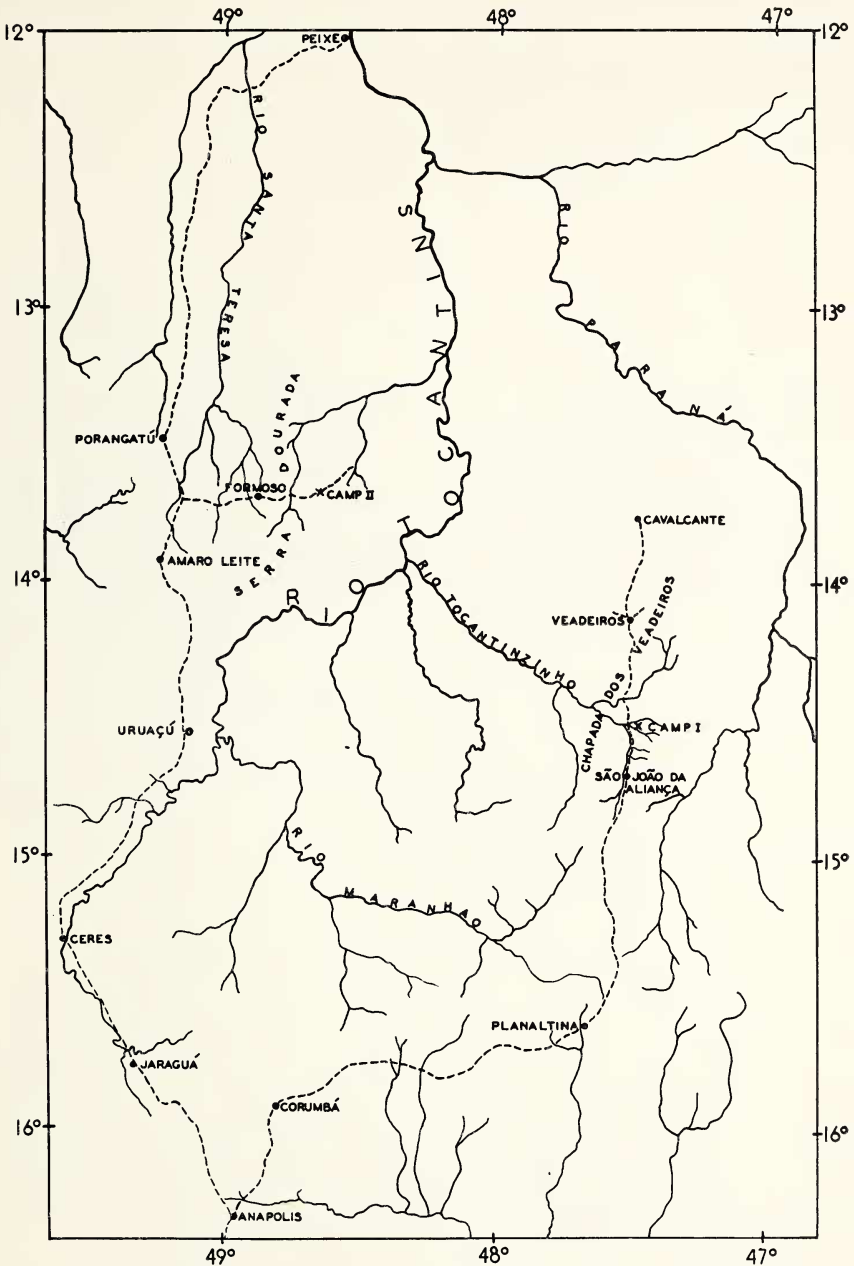
The collections and studies of these 19th Century explorers were incorporated into the monumental, sixty-six year work on Brazilian botany, *Flora Brasiliensis*<sup>3</sup>. However, after the appearance of Ule's account in Cruls' report of 1894, virtually nothing was written on the flora

<sup>2</sup>L. Cruls: Comissão exploradora do Planalto Centrál do Brasil, relatório a apresentado a S. Ex. o Sr. Ministro da Industria, Viação e Obras Publicas. Rio de Janeiro, 1894, pp. 339-365.

<sup>3</sup>Martius, Carl F. P. von, *Flora Brasiliensis*. 15 fol. vol. [in 40] Monachii, Lipsiae. 1840-1906.



Map 1. The rectangle outlines the area studied by the Expedition and shown in detail in Map 2.



Map. 2. Detail of area shown by the rectangle in Map 1.

of Goiás for more than half a century until Leo Waibel published, in 1948, his "Vegetation and land use in the Planalto Central of Brazil."<sup>4</sup>

Inasmuch as Flora Brasiliensis treats of Brazilian plants as a whole, and neither Waibel's, Ule's nor any other paper deals floristically with particular localities in the Brazilian highlands, it is hoped that the present series of contributions, which are intended to provide a survey of the "spring" floras of the Chapada dos Veadeiros and of the Serra Dourada, will find a useful and unoccupied place in Brazilian botany.<sup>5</sup>

#### ECOLOGY

Throughout the Planalto Central, which is essentially a post Cretaceous peneplain, sandstone is the predominant parent rock material. The resulting soils are for the most part sandy and poor, and they support an open vegetation. In some areas, however, the soils are derived from volcanics and are now, or were in past times, forested. The surface deposits largely consist of highly permeable accumulations of sand, gravel, pebbles and ferruginous concretions. The exceedingly high permeability of the soil, in which water may be stored in a quantity roughly equal to three years' rainfall, is a distinctive feature of the region and one that profoundly affects the type of vegetation occurring upon it.

The climate of the Planalto is one of marked diurnal variation in temperature and of distinctly seasonal rainfall. Daytime temperatures are generally high and the nights cool enough to induce extremely heavy dew. Rainfall is largely confined to the months from October through April with little rainfall during May or September, and rarely any at all from June through August. Our visit to the region in 1956 was met by somewhat unseasonable rainfall which extended well into the month of May and prolonged by several weeks the flowering season of the herbaceous plants. Good collecting, therefore, continued almost to the end of our encampment in mid-June.

Notwithstanding the widespread misconception to the contrary, approximately half of the lands of Brazil are covered, not with dense, tropical forests, but with poor vegetations such as grasslands, scrub forests and thorn bush. Almost the whole state of Goiás lies outside the heavily forested region and is largely occupied by a scrub forest and grass vegetation known as *campo cerrado* or, simply *cerrado*. About three quarters of the Planalto Central with which we are concerned here is covered with *cerrado* vegetation (Fig. 1). This consists of

<sup>4</sup>Geographical Review 38:529-554. 1948.

<sup>5</sup>A recent paper which should be mentioned here is Geraldo Mendes-Magalhães' Características de alguns tipos florísticos de Minas Gerais (Brasil) I. Bol. Soc. Portug. Ciências Nat. ii, 5(2): 91-113. 1955.





Fig. 1. *Cerrado* vegetation as seen in the vicinity of Camp I north of São João da Aliança, April 1956.

low, twisted trees 3 to 8 m. tall, with irregular crowns, thick, corky bark, and large, leathery leaves that, for the most part, remain on the trees into the second half of the dry season, and some through to the end. The ground cover is of tall grass and scattered low shrubs.

To understand the nature of the *cerrado* one must consider the ecology of the region in comparison with that of adjoining areas supporting different floras. Firstly, as indicated above, the *cerrado* is subject to a prolonged dry season, usually completely rainless from May through September. This seasonal rainfall sets the region apart from the rainforest territories to the north and west in the Amazon Basin. Secondly, the *cerrado* vegetation occupies an extremely porous soil with immense water reserves equal to the total rainfall of two or three years. This soil condition is the principal factor governing the distinction of the *cerrado* from the *caatinga* vegetation to the east and northeast in Bahia and Pernambuco states. In the *caatinga*, which consists of thorn brush and columnar cacti, the rainfall may be from less than half to nearly as much as in the *cerrado*, but evaporation is high and there are no water reserves in the soil during the whole year. The *caatinga* does not contain a prominent element of broad-leaf, non-deciduous small trees such as occur in the *cerrado*.

The explanation of the occurrence of a broad-leaf, essentially ever-green vegetation in an area subject to intense insolation and prolonged seasonal drought has been given by Mario G. Ferri in a comparative study of the water economy of the *cerrado* and *caatinga* vegetation.<sup>6</sup> He found the *cerrado* to be made up of plants with three principal types of behavior, namely, 1) those without any restriction of water expenditure throughout the dry season; 2) those with a small restriction at the end of the dry season; and 3) those with some restriction at the beginning and throughout the dry season. Of these, all but a few of the plants exhibited a type 1 behavior in direct opposition to the situation in the *caatinga* vegetation where all plants showed a pronounced restriction of water expenditure even during the rainy season. He found the unrestricted transpiration in the leaves of *cerrado* plants due to the continuously open condition of the stomata. In most cases they do not close at all, and compensation for the consequent water loss is affected by efficient transport of water from the virtually unlimited reserves in the soil.

Although the majority of the deep-rooted trees and shrubs of the *cerrado* remain more or less green throughout the dry season, the herbaceous vegetation becomes completely dead and dry by June or July, and

<sup>6</sup>Univ. de São Paulo, Fac. de Fil., Ciên. e Letras, Boletim 195 (botânica 12): 1-170. 1955.





Fig. 2. A view on the Chapada dos Veadeiros to show a narrow gallery forest following the course of a small stream. In the foreground is *campo sujo* grading into *campo limpo* across the stream. Note the numerous low termite mounds overgrown with grass and indicating the former presence of woody vegetation.

is susceptible to man-made fires which burn over nearly the whole of the Planalto, and, indeed, much of central Brazil, every year. The firing, as currently practiced by the Brazilian *fazendeiros* to keep the land open for grazing or to clear it for agriculture, is not a modern innovation. The Indians have for centuries used burning as a means of obtaining game animals whose taste for the succulent, fresh vegetable shoots coming up after the fires made them an easy prey. As a result of these destructive practices the stature of the vegetation has steadily been reduced and the scrubby *cerrado* extended at the expense of heavier forest which has been pushed back to the margins of streams and swamps in many areas. Thus, the *cerrado* is surely not a climax vegetation, for it does not seem to represent the maximum vegetation that the ecological conditions can maintain. Indeed, one sees in areas of especially severe and frequent burning the deterioration of even the scrubby, fire-resistant *cerrado* to produce *campo sujo* or clean grasslands (*campo limpo*) in which trees and shrubs are all but eradicated (Fig. 2). On the other hand, one can find occasional small areas that have been protected in some way for several years from the fires. In these the *cerrado* vegetation has become tall and close (known as *cerradão*), and there is evidence that continued protection would give rise to the development of the *mato de segunda classe* or second class forest described by Waibel, such as now persists along most of the streams and rivers of the Planalto.

Next to the *cerrado*, this second class forest is the most prominent vegetation type in the Goiás highlands. It consists of trees 12 to 20 m.

tall that become up to 30% leafless during the dry season. It does not often occur in extensive stands, but rather in patches, in depressions or at the headwaters of streams and rivulets. Usually these island forests become narrow gallery forests downstream as they confine themselves to the banks of the streams and rivers and stand in sharp contrast to the open *cerrado* and grassy *campo sujo* vegetation which adjoin them (Fig. 2).

Occasionally in the Planalto one encounters a third type of vegetation where exceptionally favorable soil fertility, ample water, and long freedom from fire have given rise to a heavy, three-layered forest, the *mato de primeira classe*. A considerable amount of this fine forest type occurs in the Serra Dourada area (Fig. 3), and a small patch was observed in the Chapada dos Veadeiros. Its upper layer consists of a canopy of trees 20 to 30 m. tall that are almost all deciduous during the dry season; the second layer of trees is 5 to 15 m. tall and mostly retains its leaves all year, while the forest floor layer of herbs and shrubs are evergreen. Despite the magnitude of the trees and the density of growth, neither this nor any forest of the Planalto exhibits a conspicuous element of lianas or epiphytes such as are so prevalent in Brazilian forests subject to more regular and uniform rainfall.

#### COLLECTING AREAS

The first botanical collections were made April 13 to May 7 in the vicinity of Base Camp I located 20 km. north of São João da Aliança adjoining a small tributary of the Rio Tocantinzinho (see map 2). The camp was situated in a grassy clearing on a low, spreading knoll elevated 8 to 15 m. above two small streams to the south and north. The vegetation immediately surrounding camp consisted of *cerrado* (Fig. 1), and, where burning appeared to have been more frequent or complete, of *campo sujo* with only scattered low shrubs, sparse trees and tall grass among which numerous termite mounds indicated the former presence of woody vegetation (Fig. 2). The herbaceous vegetation was coming into full flower by mid-April, and was kept in growing condition beyond its usual time by the frequency of rains which, after two weeks drought, began to fall on April 22 and continued almost daily into May as moderate to heavy showers. It was notable that even during the heaviest rains, the large quantities of water pouring off the tents and canvas flies of the camp were almost immediately taken up by the ground with scarcely any runoff of more than a few minutes duration. The soil was constantly wet, and within only three weeks' time the bottoms of the tents had begun to rot out. The streams flowed at nearly the same volume on rainy days as on dry ones.

Nightly dew was extremely heavy, even to the point of moderate





Fig. 3. First class forest on the road east of Formoso, May 1956.

condensation inside the tents. Partial compensation for the disadvantages of the moisture was afforded by the comfort of the pleasantly cool nights, but early morning collecting excursions through the *cerrado* or the streamside vegetation were never less than a thoroughly soaking experience.

Two hundred meters to the south was the nearest forested area, consisting of moderate to well-developed second class gallery forest narrowly following the course of the stream known on the south bank as

Jatobá and on the north bank as Pedras de Amolar. This forest was conspicuous in its lack of prominent epiphytic growths, of lianas, or of large ferns. Palms were not altogether prominent, although they were common in large patches downstream a few kilometers from camp.

Upstream a few hundred meters and east of camp was a shallow pond and marsh characteristic of the Planalto throughout which shallow lakes, marshes and springs of various sizes occur abundantly on the surface of the water-filled soil.

Above the camp to the east, and westward across the river to the highest visible point (at perhaps an elevation of 1200 meters), the *cerrado* vegetation continued interruptedly, broken by larger or smaller areas of open *campo sujo*, or the clean *campo limpo* grasslands. Throughout the area there was evidence of burning during each of several previous years. Only in a small area five km. south of camp was there a well-developed *cerrado* vegetation which had been permitted, by some natural barrier against fire, to grow up during several successive years without burning. Along the road cut through this *cerradão* one could find good specimen plants of *cerrado* trees and shrubs which elsewhere were markedly reduced.

A quality of vegetation approximating in height and luxuriance the *mato de primeira classe* as described by Waibel was encountered only in a small patch on a wet hillslope above a meandering stream 2 km. south of camp. Several species of forest palms and large ferns occurred there and not in the lower, second class forest.

Rocky outcrops in the vicinity of Base Camp I were negligible, but 35 to 60 km. to the north, in the vicinity of Veadeiros, extensive sandstone outcrops (Fig. 5) occurred in a more broken terrain of rocky hills and buttes separated by sweeping grassy valleys (Fig. 4) with numerous marshes, small lakes and countless springs. Roughly eroded sandstone hillsides provided the first collections of succulent terrestrial xerophytes, including cacti, in a semi-*caatinga* vegetation distinct from the *cerrado*. Some of these rocky outcrops, with their columnar cacti and comparatively sparse vegetation of somewhat sonoran desert aspect, were surrounded by abundant springs and seepages and extensive marshy grasslands sloping down to streamside bogs in the valleys. Even in the most elevated portion of the Chapada dos Veadeiros, near the tops of the hills on the road from Veadeiros to Cavalcante (el. 1350 m.), the ground during our visit in early May was saturated with water that poured from innumerable springs.

Collections from May 12 to June 15 were made out of Base Camp II located in the southern Serra Dourada 20 km. east-southeast of Formoso in Amaro Leite County. The camp was situated in one of the few small



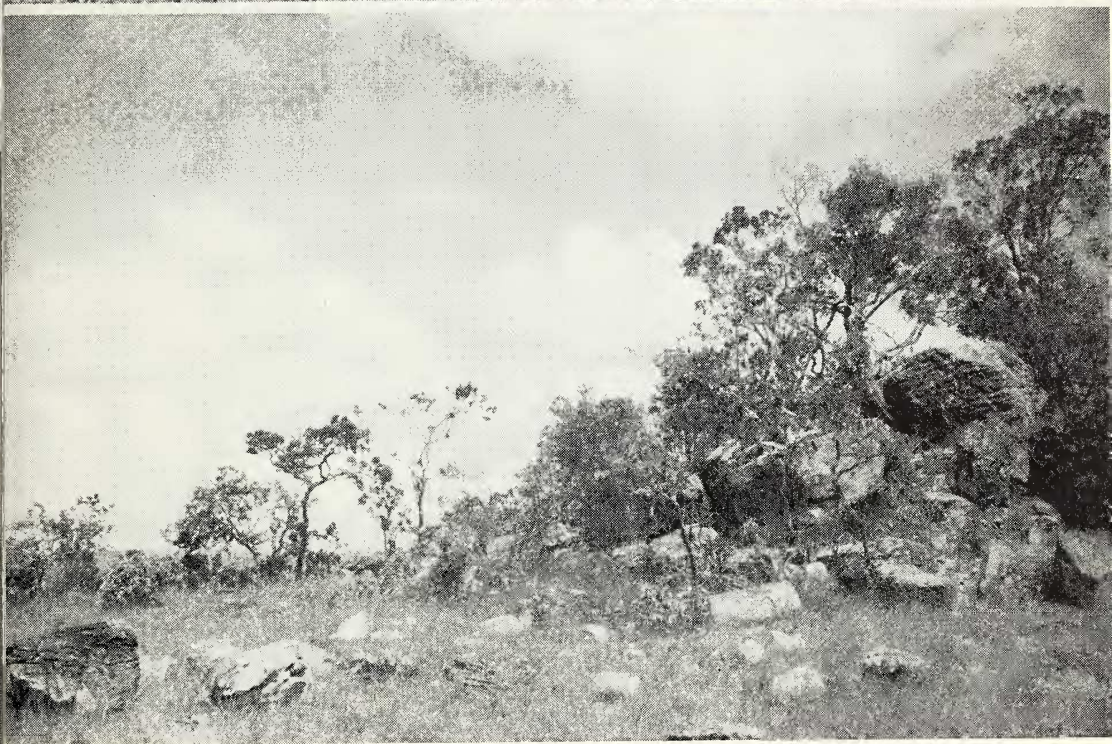


Fig. 4. (Above) An extensive *campo limpo* area on the road from São João da Aliança to Veadeiros. The hills in the background are in part openly eroded sandstone.

Fig. 5. (Below) A sandstone outcrop 7 km. south of Veadeiros.



open *cerrado* areas, on a flat hill shoulder near the top of the sub-range known as Serra do Rodovalho.

The vegetation of the immediate surroundings consisted of a typical, well-developed *cerrado* on the hills and flats to the east and north for 300 to 600 meters beyond which the growth enlarged to gallery forests along converging streams. To the immediate west of camp a very small rivulet flowed through hills showing numerous rocky outcrops, into a large rock basin which provided washing facilities, and then on through an enlarging gallery forest to the north. Upstream the vegetation was typical *cerrado* except for a narrow line of small trees and bushes standing in the stream. Xerophytic bromeliads grew on the rocks of the area, but no other terrestrial succulent occurred on the typically *cerrado*-type soil of high water reserve.

During the middle of May the herbaceous vegetation was in well advanced flowering and the grasses nearly gone. The decline continued to a late stage by mid-June. The flowering of the arboreal vegetation in the *cerrado* and gallery forests was spotty in May and somewhat more widespread in June, but it was clear that flowering of perennial species occurs at various times of the year depending upon the individual species.

A few moderate to heavy showers fell during May as the unusually late rainy season drew to a close. By early June the weather became completely dry and hot by day with temperatures to 35.5° C., and cool and exceedingly dewy at night with temperatures as low as 8° C.

The Serra Dourada seems to be an area favored by the infrequency and limited extent of fires, so that the encroachment of *cerrado* into the generally prevalent second and first class forest has not been as extensive as in the Chapada dos Veadeiros. A great many small rivulets and streams dissect the low, mountainous region east of Formoso, and, not only do gallery forests follow all of these watercourses, but often fill in more or less continuously between stream beds to form extensively forested tracts. Except for small, favored spots supporting heavier and taller growth, most of the forest would correspond to the second class category described by Waibel. But, beginning on the Rio Cristalino, tributary of the Ribeirão Cannabrava of the Rio Tocantins, about 32 km. east of Formoso, a tract of forest approximating the quality of the *mato de primeira classe* extends (to judge from our aerial reconnaissance maps) continuously east, south and north for a considerable distance. The edge of this forest marks the limits of vehicular transportation and the frontier of human exploitation of the Serra Dourada lands.

The elevated region within a 10 km. radius of Base Camp II, thus, exhibited a far denser vegetation than that surrounding Base Camp I.



Instead of a dominance of *cerrado* and *campo sujo*, the former of these vegetations was only moderately developed, and the latter nearly absent. For the most part a *cerradão* occupied most of the hill slopes and crests with second class forest along the streams and bottom lands and flats, grading, in the most favorable situations, into first class forest. Unlike the Chapada dos Veadeiros area, prominent growths of large tree ferns commonly occurred along the heavily forested streams together with a greater abundance of palms (Fig. 3) and a somewhat greater prominence of epiphytes.

A partial explanation for the denser vegetation in the Serra Dourada may be found in the somewhat lower elevation there (800-1000 m.) and apparently greater rainfall and humidity. But it seems certain from a comparison with the Chapada dos Veadeiros that the lesser frequency and extend of fires has contributed in larger measure to the retention of closed forests on much of the land that might otherwise have been reduced to *cerrado*.

In the lower lands (500-650 m.), along the old railways between Amaro Leite and Peixe, there appeared to be a much greater extent of devastation on account of fire, and the proportion of *cerrado* to second class forest was very large. Indeed, *cerrado* vegetation, broken mostly by rather low, poor, streamway gallery forests dominated much of the area between Formoso, at the foot of the Serra Dourada, and Peixe on the Rio Tocantins, 250 km. by road to the north. Between June 1 and 10 a modest number of collections of both plants and animals were made along this route as supplements to the more comprehensive collections in the immediate vicinity of Base Camp II.

#### COLLECTING STATIONS AND FIELD NUMBERS

The plant collections were recorded under 1104 field numbers between April 13 and June 7, 1956. All of these were obtained in central Goiás in the regions north and northeast of Anápolis. Numbers 14133 to 14815 were obtained in the Chapada dos Veadeiros region, and numbers 14810 to 15236 between Ceres and Peixe, especially in the southern Serra Dourada. More detailed locality data are given below.

\* \* \*

14133-14232. In open grassland and *cerrado* margin on the east side of the road 20 km. north of São João da Aliança, Apr. 13-15.

14233-14260. Along the margins of a small marsh  $\frac{1}{2}$  km. east of the road, 20 km. north of São João da Aliança, Apr. 15.

14261-14276. In the *cerrado* area about 2 km. east of the road, 20 km. north of São João da Aliança, Apr. 16.

14277-14294. On an open grassy hilltop about  $2\frac{1}{2}$  km. northeast of the road, 21 km. north of São João da Aliança, Apr. 16.

14295-14376. In and along the gallery forest 20 km. north of São João da Aliança, Apr. 16-17.

- 14377-14424d. Between the gallery forest and the west side of the road 20 km. north of São João da Aliança, Apr. 19.
- 14425-14439. In the *cerrado* on the east side of the road 20 km. north of São João da Aliança, Apr. 19.
- 14440-14454. In the *cerrado* 16 km. north of São João da Aliança, Apr. 19.
- 14455-14458. On a stony hillside 14 km. north of São João da Aliança, Apr. 19.
- 14459-14463. Along the river bank of the Ribeirão Capetinga 19 km. north of São João da Aliança, Apr. 19.
- 14464-14470. In the *cerrado* 21 km. north of São João da Aliança, Apr. 20.
- 14471-14476. In the gallery forest margin west of the road 21 km. north of São João da Aliança, Apr. 20.
- 14477-14483. In a small wet ravine west of the road 21 km. north of São João da Aliança, Apr. 20.
14483. In grassland 20 km. north of São João da Aliança, Apr. 20.
- 14484-14496. In a grazed area along a stream east of the road 18 km. north of São João da Aliança, Apr. 20.
- 14497-14517a. In a forested area along a meandering stream 18 km. north of São João da Aliança, on the east side of the road, Apr. 21.
14518. On a sandstone outcrop on a hillcrest 54 km. north of São João da Aliança, Apr. 22.
14519. On a sandstone outcrop above the meadow 7 km. south of Veadeiros, Apr. 22.
- 14520a. On a sandstone outcrop 500 m. west of the road, 14 km. south of Veadeiros, Apr. 25.
- 14520-14527. On a sandstone outcrop 15 km. northwest of Veadeiros on the Cavalcante road, Apr. 22.
- 14529-14538. On the east side of the road, 18 km. north of São João da Aliança, Apr. 23.
- 14539-14557a. In grassland and margin of *cerrado* near the road, 38 km. north of São João da Aliança, Apr. 25.
- 14558-14570. Along the road 21 km. north of São João da Aliança, Apr. 28.
- 14571-14574. In a wet grotto 5 km. west of Veadeiros, Apr. 29.
14575. Along the road 8 km. west of Veadeiros, May 1.
- 14576-14577. On the Nova Roma road, 5 km. north of Veadeiros, Apr. 30.
14578. On a dry stony flat on the butte 5 km. west of Veadeiros, May 1.
- 14580-14607. On the sandstone outcrop 7 km. south of Veadeiros, Apr. 24.
- 14608-14638. Along the wet, sandy margins of the sandstone outcrop 7 km. south of Veadeiros, Apr. 24.
- 14639-14650. In the boggy field west of the road, 7 km. south of Veadeiros, Apr. 24.
- 14651-14656. On the edges of an island forest in the meadow 7 km. south of Veadeiros, Apr. 24.
14657. Along the dry margin of the meadow 7 km. south of Veadeiros, Apr. 24.
- 14658-14664. On a hillslope in the sandstone area just west of the road, 14 km. south of Veadeiros, Apr. 25.
- 14665-14669. At a boggy spring in the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.
- 14670-14673. On a grassy hillslope near the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.

- 14674-14675. On rocks in the stream below a small falls in the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.
- 14676-14688. On the sandstone rocky area along the west stream bank, west of the road, 14 km. south of Veadeiros, Apr. 25.
- 14689-14690. In a small spring bog in the canyon bottom west of the road, 14 km. south of Veadeiros, Apr. 25.
- 14691-14695. Along the road on the rocky ridge 14 km. south of Veadeiros, Apr. 25.
- 14696-14701. On bridge timbers 21 km. north of São João da Aliança, Apr. 27.
14702. On a forest log 18 km. north of São João da Aliança, Apr. 24.
- 14703-14705. In the sandstone rocky area on the west side of the stream and west of the road, 14 km. south of Veadeiros, Apr. 25.
14706. Along the road 7 km. south of Veadeiros, Apr. 24.
14707. On sandstone 16 km. north of São João da Aliança, Apr. 25.
- 14708-14709. In the sandstone area 14 km. south of Veadeiros, Apr. 26.
- 14710-14725. On the slopes and shoulder of the sandstone butte 5 km. west of Veadeiros, Apr. 29.
- 14726-14727. In a meadow grassland 6-7 km. west of Veadeiros, Apr. 29.
- 14728-14732. Along a stream at the fazenda 9 km. west of Veadeiros, Apr. 30.
- 14733-14737. Along an oxcart road 15 km. north of Veadeiros, Apr. 30.
- 14738-14751e. Near the road, 4 km. north of Veadeiros, Apr. 30.
- 14752-14765. Medicinal plants collected about the town of Veadeiros, Apr. 30.
- 14766-14767. Along a roadside just north of Veadeiros, Apr. 30.
- 14768-14803. Along the Cavalcante road 8-10 km. northwest of Veadeiros, May 1.
- 14804-14807. In a gallery forest 20 km. north of São João da Aliança, May 3.
14809. In a stream crossing the Cavalcante road at 15 km. north of Veadeiros, Apr. 25.
- 14810-14813. In a *cerrado* area 28 km. southwest of Veadeiros, May 3.
- 14814-14815. In *cerrado* along the road, 38 km. south of Veadeiros, May 3.
- 14816-14836. In the *cerrado*-gallery forest margin 20 km. east of Formoso, May 15.
- 14837-14923. Along banks and margins of small stream running through *cerrado* and into gallery forest 20 km. east of Formoso, May 16-17.
- 14924-14946. In deep forest along the Rio Cristalino 25 km. east of Formoso, May 18.
- 14947-14954. In the gallery forest area 20 km. east of Formoso, May 18.
14955. On the sandstone rocky outcrop about 40 km. south of Uruaçu on the Ceres road, May 12.
- 14956-14963. Along a small stream running through *cerrado* 20 km. east of Formoso, May 18.
- 14964-14988. In the margins and interior of gallery forest about 17 km. east of Formoso, May 19.
- 14989-14993. Near the road, 20 km. east of Formoso, May 19.
- 14994-15010. Along and near an affluent of the Ribeirão Cannabrava about 28 km. east of Formoso, May 20.
- 15011-15013. In the vicinity of the road, 20 km. east of Formoso, May 20.
- 15014-15016. In the forested area about 28 km. east of Formoso, May 20.
- 15017-15032. In the forested area east of the Rio Cristalino about 34 km. east of Formoso, May 21.
- 15033-15042. Along the stream margins about 22 km. east of Formoso, May 21.

- 15043-15071. In forest and forest margin along the road between 22 and 33 km. east of Formoso, May 22.
- 15072-15083. In forest margin and *cerrado* 18 km. east of Formoso, May 23.
- 15084-15085. In forest, 17 km. east of Formoso, May 23.
- 15086-15087. In forest, about 24 km. east of Formoso, May 23.
15088. In the forested area 20 km. east of Formoso, May 23.
- 15089-15101. Along the road 10 to 13 km. east of Formoso, May 24.
15102. In gallery forest 22 km. east of Formoso, May 23.
- 15103-15108. In the vicinity of the road at 20 km. east of Formoso, May 24.
- 15109-15110. On a sandstone outcrop 3 km. south of Uruaçu, May 25.
15111. On a sandstone outcrop 3 km. west of Formoso, May 26.
- 15112-15116. On a rocky sandstone hilltop 16 km. east of Formoso, May 27.
15118. In the forest 22 km. east of Formoso, May 24.
15119. On a palm in the forest margin 12 km. east of Formoso, May 25.
15120. Cultivated at Amaro Leite from a nearby woodland, May 25.
- 15121-15135. In heavy forest along the road, 13 km. east of Formoso, May 28.
15136. In a drying road puddle 2½ km. southwest of Peixe, June 1.
15137. Cultivated at Peixe, May 31.
15138. In a road puddle 5.8 km. southwest of Peixe, June 2.
- 15139-15143. In a shallow vernal swamp 11.5 km. southwest of Peixe, June 2.
15144. In a road puddle 14 km. southwest of Peixe, June 2.
- 15145-15146. In a road puddle 18 km. southwest of Peixe, June 2.
- 15147-15155. Along a small flowing stream in the sun 25 km. southwest of Peixe, June 2.
15156. In a flowing rivulet 30 km. southwest of Peixe, June 2.
15157. In a flowing rivulet 32 km. southwest of Peixe, June 2.
- 15158-15164. In and beside a flowing rivulet 35 km. southwest of Peixe, June 2.
15165. In a slow moving stream 41 km. southwest of Peixe, June 2.
15166. In a flowing stream 43 km. southwest of Peixe, June 2.
- 15167-15169. In a fast flowing stream 48 km. southwest of Peixe, June 2.
- 15170-15174. Along the bank of the Rio Santa Teresa 50 km. southwest of Peixe, June 2.
- 15175-15176. On a rock outcrop 80 km. southwest of Peixe, June 2.
- 15177-15178. In a very slow moving rivulet 124 km. south-southwest of Peixe, June 3.
- 15179-15186. Along a small rivulet 127 km. south-southwest of Peixe, June 3.
15187. In a road puddle 137 km. south-southwest of Peixe, June 3.
- 15188-15191. In a drying rivulet in the forest 140 km. south-southwest of Peixe, June 3.
- 15192-15198. In a forest stream and marginal area 143½ km. south-southwest of Peixe, June 3.
- 15200-15217. Along a small stream flowing over rocks 20 km. east of Formoso, June 4.
- 15218-15227. Along the road 15-20 km. east of Formoso, June 4.
- 15228-15232. In a small stream flowing over rocks 21 km. east of Formoso, June 6.
- 15233-15234. In the *cerrado* area 20 km. east of Formoso, June 7.
15235. Along the road 8 km. east of Formoso, June 8.
15236. On a rocky outcrop beside a small stream flowing through *cerrado* 20 km. east of Formoso, June 10.